



U.S. Department
of Transportation
**National Highway
Traffic Safety
Administration**

DOT HS 807 464
Final Report

June 1989

Installation of Child Safety Seats in Selected 1988-1989 Model Year Automobiles

The United States Government does not endorse products or manufacturers. Trade or manufacturers' names appear only because they are considered essential to the object of this report.

1. Report No. DOT HS 807 464	2. Government Accession No.	3. Recipient's Catalog No.	
4. Title and Subtitle Installation of Child Safety Seats in Selected 1988-1989 Model Year Automobiles		5. Report Date June 1989	6. Performing Organization Code
7. Author(s) Peter Finn, Marianne Beauregard, Stacey Macek Alfredo Rodriguez		8. Performing Organization Report No.	
9. Performing Organization Name and Address Abt Associates Inc. 55 Wheeler Street Cambridge, Massachusetts 02138		10. Work Unit No. (TRAIS)	11. Contract or Grant No. DTNH22-88-C-07013
12. Sponsoring Agency Name and Address U.S. Department of Transportation National Highway Traffic Safety Administration Office of Driver and Pedestrian Research Washington, D.C. 20590		13. Type of Report and Period Covered Final Report 7/25/88-6/30/89	
15. Supplementary Notes This publication reports the results of the second of two studies involving selected 1988-1989 model year automobiles. The companion volume to this report describes a Comparison of the Comfort and Convenience of Automatic Safety Belts Systems among Selected 1988-1989 Model Year Automobiles.		14. Sponsoring Agency Code NHTSA/NRD-41	
16. Abstract <p>The study tested whether currently marketed child safety seats are difficult to install in current model automobiles. The study also tested whether once installed, the child seats remain securely fastened when rocked or tilted. Thirteen toddler and four infant safety seats were tested in 8 to 17 1988-1989 model year automobiles. In general, problems with the installation and use of child safety seats differed significantly by test vehicle but did not vary significantly by child seat. A few more problems were found in the rear window position as compared with the rear center position. Installation and use in the front passenger position appear to present many more problems as compared with the rear seat positions. Recommendations of some manufacturers not to install child safety seats in the front seats of automobiles with motorized safety belts systems were thus confirmed.</p>			
17. Key Words Safety Belts Automatic Safety Belts Child Seats Child Restraint Devices		18. Distribution Statement Document is available to the U.S. public through the National Technical Information Service Springfield, Virginia 22161	
19. Security Classif. (of this report) Unclassified	20. Security Classif. (of this page) Unclassified	21. No. of Pages 27	22. Price

Table of Contents

INSTALLATION OF CHILD SAFETY SEATS IN SELECTED 1988-1989 MODEL YEAR AUTOMOBILES

	<u>Page</u>
Preface	
Executive Summary	1
1 Introduction	3
Background	3
Purposes of the Child Safety Seat Study	3
2 Test Design and Procedures	5
3 Data Analysis and Results	9
Overview	9
Types of Problems by Vehicle	12
Problems by Child Seat Model	12
References	18
Appendix A Child Safety Restraint Device Evaluation Form	21
Appendix B Installation or Use Problems by Child Safety Seat, Test Vehicle, and Seat Location: Toddler Seats	25
Appendix C Installation or Use Problems by Child Safety Seat, Test Vehicle, and Seat Location: Infant Seats	27
List of Exhibits	
Exhibit 1 Child Safety Seats Tested	6
Exhibit 2 Questions from the Child Safety Restraint Examination Form Used in the Analyses	10
Exhibit 3 Percentage of Trials with Problems by Seat Position: Toddler Seats	11
Exhibit 4 Percentage of Trials with Problems by Seat Position: Infant Seats	11
Exhibit 5 Frequency of Each Type of Problem by Test Vehicle and Seat Position: Toddler Seats	13
Exhibit 6 Frequency of Each Type of Seat Problem by Test Vehicle and Seat Position: Infant Seats	14
Exhibit 7 Total Installation and Use Problems by Child Safety Seat: Toddler and Infant Seats	15
Exhibit 8 Type of Seat Problem by Child Seat and Vehicle Seat Position: Toddler Seats	17

Preface

This publication presents the results of the second of two studies conducted by Abt Associates Inc. in 1988-1989. This study was an examination of the compatibility of child safety seats with these same automobiles. The companion study was a comparison of the comfort and convenience of the automatic safety belt systems in seventeen 1988-89 model year automobiles.

Installation of Child Safety Seats in Selected 1988-1989 Model Year Automobiles

Executive Summary

The National Highway Traffic Safety Administration recognized the need to reexamine how easily and securely currently available child safety seats can be installed in recent model automobiles. The last study to test the installation of child seats was conducted in 1980. In addition, Federal Motor Vehicle Safety Standard 208 requires the installation of automatic protection systems in all new cars effective with model year 1990. Most manufacturers are meeting the standard by equipping their automobiles with automatic safety belts (the rest are using air bags). Thus, there was also a need to examine child safety seat installation and use in vehicles equipped with automatic safety belts.

To achieve this goal, NHTSA contracted in 1988-1989 with Abt Associates Inc. to conduct a study to test the installation of child seats in 17 current model automobiles.

This study was purposely designed to identify problems associated with a relatively recent technological innovation in highway traffic safety--child safety seats. Studies had already shown that this innovation saves lives and has met with consistent driver approval. However, there was a need to identify any current problems with child safety seats so that what have already been shown to be a life-saving technology might be improved still further.

Study Goals

This study was designed to determine the extent to which currently marketed child safety seats are difficult to install in current model automobiles. The study also tested whether, once installed, the child seats remain securely fastened when rocked or tilted.

The study was designed to identify installation and secureness problems rather than to focus on overall characteristics of child seat use or to identify positive features of the child seats. This focus was chosen in order to identify difficulties with child seats that might be corrected.

Study Design

Seventeen child seat models were selected based on the number manufactured in 1987 and the inclusion of a representative group of newer seats for which manufacturing figures were not yet available. The seventeen child seat models represented nine different manufacturers. While many of the seats were "convertible"--designed for use for toddlers and infants by installing them facing front or facing back--all but one of the convertible seats were tested in the toddler position only. A total of 13 toddler seats and 4 infant seats were tested.

Experimenters were trained in the correct installation procedures. They then installed the child seats in each automobile, going from vehicle to vehicle according to a random sequence developed from a Latin square design. After installing the seat, the experimenters informally tested the extent to which it rotated and tilted forward from the automobile seat by twisting and tugging the seat manually with moderate force. The experimenters recorded their observations on (1) ease of installation, (2) problems associated with installation, (3) whether the child seat interfered with operation of the automatic belt system (front seat only), and (4) looseness of the child seat once installed.

Findings

In general, problems with the installation and use of child safety seats differed significantly by test vehicle but did not vary significantly by child seat. As concerns installation position, a slightly greater number of problems were found in the rear outboard position as compared with the rear center position. The problems are largely associated with use of the seats in those locations, rather than with their installation. That is, once installed, seats are sometimes not secure, rotating and moving forward excessively when pushed. However, installation and use of child seats in the front passenger position appears to present many more problems as compared with the rear seat positions. The tests thus confirmed the recommendations of some manufacturers not to install child safety seats in the front seat of automobiles with motorized safety belt systems.

Introduction

The study of comfort and convenience reported in the companion volume to this report assembled seventeen 1988 and 1989 model year cars in a single location and hired thirty individuals to assist with the study. This provided an opportunity to gain some rough information on the nature of problems that consumers might be likely to encounter with installation of current model child safety seats in recent model automobiles.

Background

There has been a dramatic change in the use of child safety seats during the 1980s. While only 23 percent of children in cars entering shopping center parking lots were observed using child safety seats in 1982, over 83.5 percent were using them in 1988 (Ziegler, 1989). Equally important, between 1983 and 1986 there was a doubling of the correct installation of child safety seats (from 39 percent to 78 percent of seats in use). The last study to test child seats with automobile safety belt systems was conducted in 1980 (Tom et al., 1981).

Purposes of the Child Safety Seat Study

This study was conducted with the intent of characterizing child safety seat installation in a variety of new passenger cars by individuals possessing a minimum level of child passenger safety technical expertise. The results of the study reflect the level of difficulty that was perceived by these individuals in the installation of the child seats and their perceptions of the correct fit of these child seats. The correct installation and fit of the child seats were not assessed according to an absolute standard. No attempt was made to measure or control inter-rater reliability.

Seventeen child seats were tested in the rear outboard and center seats of seventeen 1988-1989 model year automobiles. The rear-seat tests were designed to answer the following questions:

1. Which combinations of child seats and automobiles, if any, present difficulties in rear seat installation?
2. Once installed, which combinations of child safety seats and automobiles, if any, prevent the child seats from remaining securely fastened when rocked or tilted?

The child seats were also tested in the front passenger seat of nine automobiles with motorized belt systems. The front seat tests were designed to answer three questions:

1. Which combinations of child seats and automobiles, if any, present difficulties in front seat installation?
2. Which combinations of child seats and automobiles, if any, cause interference problems with the operation of the motorized safety belt system?
3. Once installed, which combinations of child safety seats and automobiles, if any, prevent the child seats from remaining securely fastened when rocked or tilted?

The owner's manuals for at least some automobiles with motorized belt systems recommend that buyers not use the front seat to install child safety seats. However, it was still important to test child seats with these vehicles in the front seat because many people who use child seats may not read the owner's manual or be told about its recommendations.

A final purpose of the study was to learn whether there are different kinds of problems and their relative frequencies associated with installing and securely fastening child safety seats in different current automobiles.

As stated above, the study was deliberately designed to identify installation and secureness problems rather than to focus on overall characteristics of child seat use or to identify positive features of the seats. This focus was chosen in order to maximize opportunities to identify difficulties with child safety seats that could be corrected in an effort to improve the documented safety benefits that child seats provide.

Test Design and Procedures

Seventeen child seat models were selected based on the number manufactured in 1987 and the inclusion of a representative group of newer seats for which manufacturing figures were not yet available. The seventeen child seat models tested represented nine different manufacturers (Exhibit 1). While many of the seats were "convertible"—designed for use for toddlers and infants by installing them facing front or facing back—all but one of the convertible seats were tested in the toddler position only. A total of 13 toddler seats and 4 infant seats were tested.

Each seat was tested in up to seventeen current model automobiles with motorized and non-motorized automatic safety belt systems in the front seats and manual belt systems in the rear seats. (For information about the vehicles, see Chapter 3 of the companion study, "A Comparison of the Comfort and Convenience of Automatic Safety Belt Systems among Selected 1988-1989 Model Year Automobiles.") As appropriate, the child seats were tested in each of three positions in each automobile: rear outboard (window) seat, rear middle seat (except for automobiles with no rear middle seat), and front passenger seat. The child seats could not be tested in the front seat of eight test automobiles with non-motorized automatic belt systems because these vehicles did not have manual lap belts in the front seats. In addition, two vehicles had no middle rear seat.

Experimenters were divided into eight pairs, with every pair but one responsible for installing two child safety seats (one team installed three seats). Each pair was trained by automobile safety engineers in the correct installation procedures for its seats. Under the supervision of the safety engineers, the teams then practiced installing its seats in several of the test vehicles. The teams were also supervised during the actual testing by the automobile safety engineers.

During the test, the experimenters installed their child seats in each automobile, going from vehicle to vehicle according to a random sequence developed from a Latin square design. After installing the seat, the experimenters informally tested the extent to which it rotated and tilted forward from the automobile seat by turning and tugging the seat manually with moderate force. The experimenters recorded their observations on (1) ease of installation, (2) problems associated with installation, (3) whether the child seat interfered with operation of the automatic belt

Exhibit I

Child Safety Seats Tested

Toddler Seats

<u>Manufacturer</u>	<u>Model</u>
Century	200
Century	2000 STE
Cosco	Car Seat
Evenflo	7-Year
Evenflo	Ultara
Fisher Price	Car Seat
Gerry Guardian	Convertible
Kolcraft	Perfect Fit
Nissan	Child Safety Seat
Pride Trimble	Pride Ride
Strolee	609
Strolee	626
Strolee	GT 2000

Infant Seats

Century	Infant Love Seat
Evenflo	Dyn-O-Mite
Kolcraft	Rock-N-Ride Carrier
Strolee	626

system (front seat only), and (4) looseness of the child seat once installed. A copy of the observation instrument may be found in Appendix A.

Data Analysis and Results

As noted above, for policymaking purposes Study Two was designed deliberately to identify problems associated with the installation and secureness of the child seats rather than to evaluate overall characteristics of child seat use.

The analysis focused on four potential problems. An installation problem was indicated if there was any difficulty in installing the seat. An interference problem was noted if the child seat interfered with the operation of the automatic safety belt (front passenger position only). If the child seat rotated more than 30 degrees when pulled from side to side, a rotation problem was indicated. Similarly, a forward motion problem was noted if the top of the child seat moved six or more inches when pulled toward the front of the car.¹ The data elements from the child safety restraint questionnaire used to identify each type of problem are displayed in Exhibit 2. In the remaining exhibits, the numbers shown are counts of the total number of problems occurring in each cell.

Overview

In general, problems with the installation and use of child safety seats differed significantly by test vehicle but did not vary significantly by child seat. As concerns installation position, a slightly greater number of problems were found in the rear window position as compared with the rear center position. (See Exhibit 3 and Exhibit 4.) The problems are largely associated with use of the seats in these locations, rather than with their installation. That is, once installed, seats are sometimes not secure, rotating and moving forward excessively when pushed. However, installation and use of child seats in the front passenger position (where there were motorized automatic safety belt systems) appears to present many more problems as compared with the rear seat positions (where there were manual belts). The tests thus confirmed the recommendations of some manufacturers not to install child safety seats in the front seat of automobiles with motorized safety belt systems.

¹Experimenters measured informally the movement of the child seat from side to side and forward by exerting moderate force with their hands to pull the seat out of position.

Exhibit 2

Questions from the Child Safety Restraint Device Examination
Form Used in the Analyses

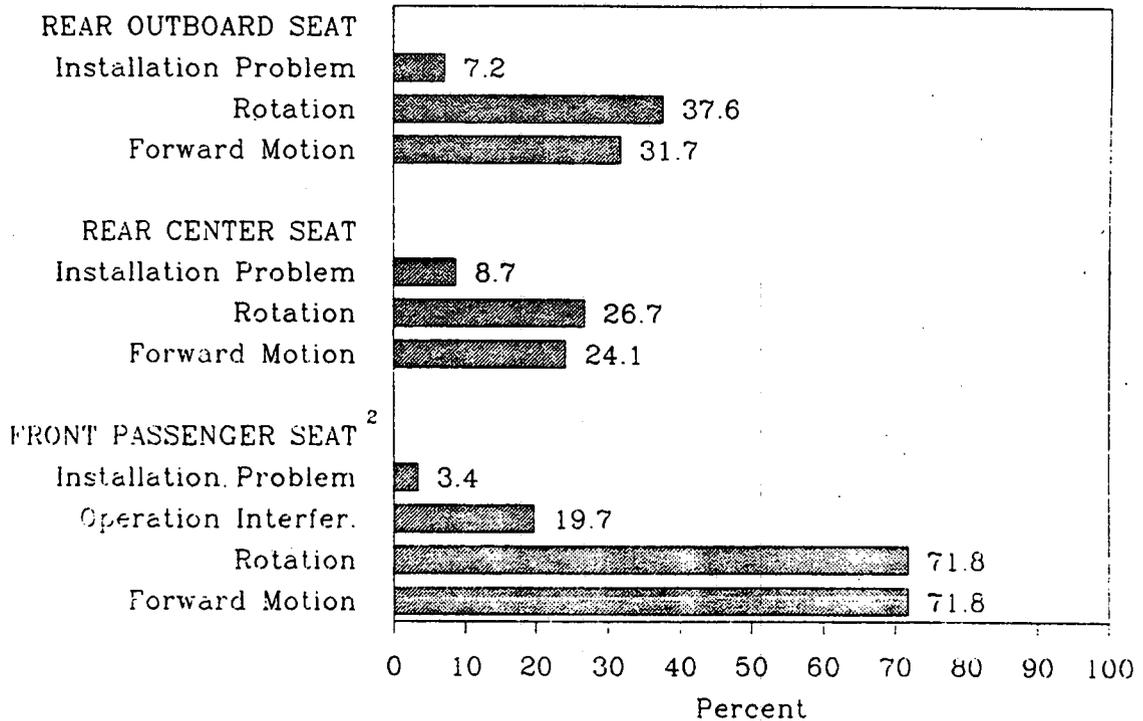
Child Seat Position/ Type of Problem	Column on Questionnaire Where Question May Be Found*	Associated Question(s)
Front Passenger		
Installation Problem	16	Was there any problem installing the seat?
Installation Interference	23	Did the automatic belt system interfere with the process of installing the seat?
Operation Interference	24	Does the child seat interfere with operation of the automatic safety belt?
Rotation	31	Does the child seat rotate more than 30 degrees or come loose when pulled from side to side?
Forward Motion	18	Distance child seat pitches forward when pulled.**
Rear Outboard		
Installation Problem	33	Was there any problem installing the seat?
Rotation	40	Does the child seat rotate more than 30 degrees or come loose when pulled from side to side?
Forward Motion	41	Distance child seat pitches forward when pulled.**
Rear Center		
Installation Problem	42	Was there any problem installing the seat?
Rotation	49	Does the child seat rotate more than 30 degrees or come loose when pulled from side to side?
Forward Motion	50	Distance child seat pitches forward when pulled.**

*See Appendix A for a copy of the questionnaire.

**A problem is indicated if the child seat moves 6 or more inches or comes loose.

Exhibit 3

Percentage of Trials with Problems by Seat Position:
Toddler Seats¹

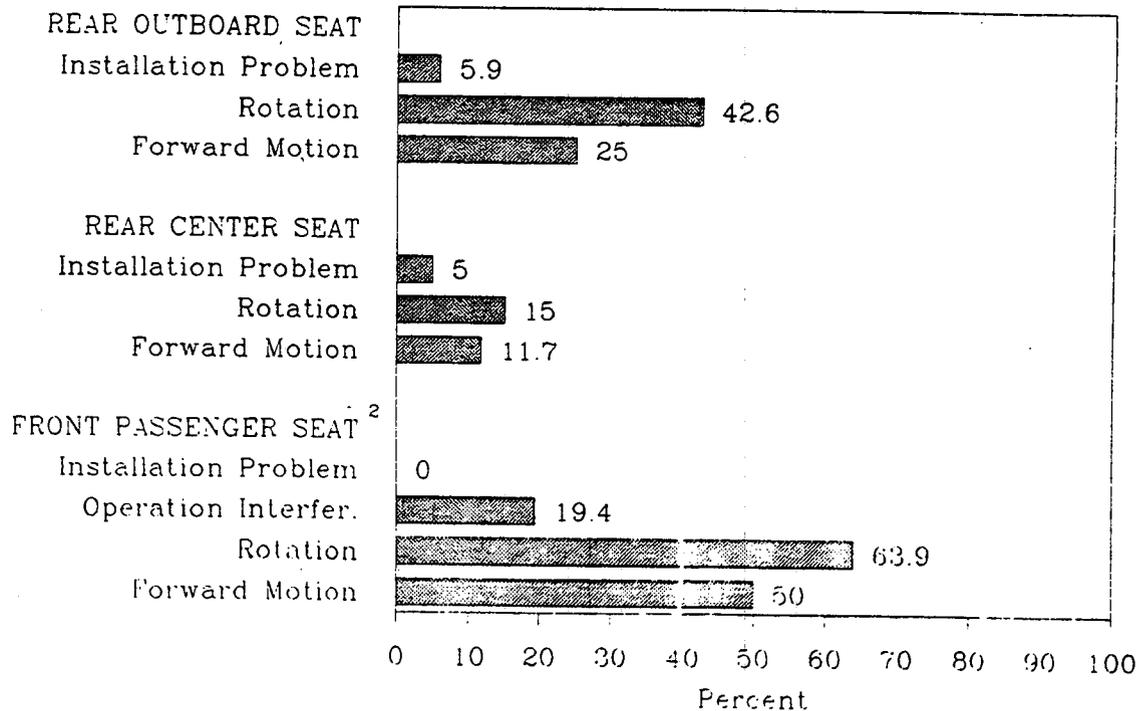


¹ Percent of observations where at least one problem was indicated.

² The child seats were not tested in the front seat of the eight test vehicles with non-motorized automatic belt systems because these automobiles do not have manual lap belts in the front seats

Exhibit 4

Percentage of Trials with Problems by Seat Position:
Infant Seats¹



¹ Percent of observations where at least one problem was indicated.

² The child seats were not tested in the front seat of the eight test vehicles with non-motorized automatic belt systems because these automobiles do not have manual lap belts in the front seats

Types of Problem by Vehicle

Exhibit 5 shows the frequency of problems by type of problem and vehicle for toddler seats. Analysis of Variance (ANOVA) was used to determine whether the number of problems in each installation position was significantly influenced by vehicle characteristics.¹ There were three dependent variables--the total number of problems recorded for each of the three installation positions. A categorical variable representing vehicle was used as the independent variable.

The data suggest that problems occur more frequently in the rear window passenger position than in the rear center position. Problems were encountered in over 26 percent of the trials in the rear outboard position as compared with 21 percent in the rear center position. In both rear positions, problems were more likely to occur in the operation and use of the toddler seats after installation than in the installation process. Rotation and forward motion appear to be the most frequent problems. The data suggest rotation and forward movement problems occur frequently (84 percent of the trials) in the front passenger position as well. In addition, there is evidence that the child seats in the front passenger position interfere with the operation of the motorized safety belt (23 percent of the trials).

Exhibit 6 displays similar data for infant seats. As with the toddler seats, the total number of problems in each position varies significantly by vehicle. Again, problems in the rear seat positions stem principally from rotation and forward motion rather than installation. As with the toddler seats, the rear window position tends to be somewhat more problematic than the rear center position, with problems occurring in 28 percent and 18 percent of trials for rear window and rear center positions, respectively. The front passenger position, however, has the highest incidence of problems (33 percent).

Problems by Child Seat Model

Exhibit 7 shows the total number of problems and this total as a percent of possible problems for each child seat evaluated. Analysis of variance (ANOVA) on the

¹Since neither the sample of vehicles nor the sample of child safety seats was scientifically selected from its respective population, the results of this analysis can not be generalized to the vehicle population. A statistically significant result means that we would expect similar findings if the experiment were repeated with the same vehicles and child seats.

Exhibit 5

Frequency of Each Type of Seat Problem by Test Vehicle and Seat Position: Toddler Seats¹

	MAKE/MODEL	Rear Outboard				Rear Center				Front Passenger ^b						
		Installation Problem	Rotation	Forward Motion	Total ^a N %	Installation Problem	Rotation	Forward Motion	Total ^a N %	Installation Problem	Installation Interference	Operation Interference	Rotation	Forward Motion	Total ^a N %	
Motorized	Dodge Shadow	1	4	6	11 30.6	1	3	4	8 20.5	2	1	4	9	11	26 50.0	
	Ford Escort	2	1	2	5 12.8	n/a	n/a	n/a	n/a	0	n/a	1	3	2	6 11.5	
	Ford Tempo	0	3	0	3 8.3	1	3	0	4 11.1	0	n/a	0	5	5	10 20.8	
	Mazda 626	2	4	3	9 23.1	3	4	4	11 33.3	2	1	3	12	12	29 55.8	
	Mitsubishi Mirage	3	5	4	12 33.3	1	9	4	14 35.9	0	n/a	4	7	5	16 30.8	
	Nissan Maxima	0	5	4	9 23.1	2	4	9	15 38.5	0	n/a	3	12	13	28 55.8	
	Peugot 405S	2	6	6	14 35.9	0	5	2	7 19.4	0	n/a	1	13	13	27 51.9	
	Saab 900 Turbo	2	5	3	10 27.8	2	4	4	10 27.8	0	n/a	2	10	10	22 45.8	
	Toyota Camry	0	8	7	15 41.7	2	3	0	5 12.8	0	n/a	5	13	13	31 59.6	
	Total	12	41	35	88 26.2	12	35	27	74 24.9	4	2	23	84	84	195 42.4	
	Non-Motorized ^b	Hyundai Excel	0	6	1	7 19.4	1	2	0	3 9.1	n/a	n/a	n/a	n/a	n/a	n/a
		Volkswagen Jetta	0	3	3	6 16.7	1	2	5	8 20.5	n/a	n/a	n/a	n/a	n/a	n/a
Yugo GV		2	8	9	19 40.7	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	
Chevrolet Beretta		1	3	3	7 17.9	1	1	2	4 10.3	n/a	n/a	n/a	n/a	n/a	n/a	
Pontiac Bonville		0	6	8	14 35.9	0	3	7	10 25.6	n/a	n/a	n/a	n/a	n/a	n/a	
Pontiac Grand Am (2 dr)		1	5	5	11 30.6	1	1	1	3 7.7	n/a	n/a	n/a	n/a	n/a	n/a	
Pontiac Grand Am (4 dr)		0	4	1	5 12.8	0	2	1	3 8.3	n/a	n/a	n/a	n/a	n/a	n/a	
Pontiac Grand Prix		0	7	5	12 30.7	1	6	4	11 28.2	n/a	n/a	n/a	n/a	n/a	n/a	
Total		4	42	35	81 26.7	5	17	20	42 15.9	n/a	n/a	n/a	n/a	n/a	n/a	
Total		16	83	70	169 26.4	17	52	47	116 20.7	4	2	23	84	84	195 42.4	

¹The numbers in the body of the table show the number of problems reported in each cell. The number (N) shown in the total column excludes problem counts for installation interference, since this question was asked only if there was an installation Problem. The percentage (%) is the total number of problems as a percent of total possible problems.

^aThe total numbers of problems in the indicated seat position are significantly different at the 95% level of confidence among the vehicles tested.

^bThe child seats were not tested in the front seat of the eight test vehicles with non-motorized automatic belt systems because these automobiles do not have manual lap belts in the front seats.

Exhibit 6

Frequency of Each Type of Seat Problem by Test Vehicle and Seat Position: Infant Seats¹

	MAKE/MODEL	Rear Outboard				Rear Center				Front Passenger ^b					
		Installation Problem	Rotation	Forward Motion	Total ^c N %	Installation Problem	Rotation	Forward Motion	Total ^c N %	Installation Problem	Installation Interference	Operation Interference	Rotation	Forward Motion	Total ^c N %
Motorized	Dodge Shadow	0	2	1	3 25.0	0	2	1	3 25.0	0	n/a	1	3	2	6 37.5
	Ford Escort	0	0	0	0 0.0	n/a	n/a	n/a	n/a	0	n/a	0	0	0	0 0.0
	Ford Tempo	0	0	0	0 0.0	0	0	0	0 0.0	0	n/a	2	1	0	3 10.8
	Mazda 626	0	1	0	1 8.3	1	2	1	4 33.3	0	n/a	1	4	4	9 36.3
	Mitsubishi Mirage	1	4	1	6 50.0	1	2	2	5 41.7	0	n/a	0	0	1	1 6.3
	Nissan Maxima	0	3	2	5 41.7	0	0	0	0 0.0	0	n/a	1	4	3	8 50.0
	Peugot 405S	0	4	2	6 50.0	0	0	0	0 0.0	0	n/a	1	4	3	8 50.0
	Saab 900 Turbo	1	3	2	6 50.0	0	2	2	4 33.3	0	n/a	0	3	2	5 31.3
	Toyota Camry	0	2	1	3 25.0	0	0	0	0 0.0	0	n/a	1	4	3	8 50.0
	Total	2	19	9	30 27.8	2	8	6	16 18.4	0	n/a	7	23	18	48 33.3
	Non-Motorized ^d	Hyundai Excel	1	1	0	2 16.7	0	0	0	0 0.0	n/a	n/a	n/a	n/a	n/a
Volkswagen Jetta		0	0	1	1 8.3	0	0	0	0 0.0	n/a	n/a	n/a	n/a	n/a	n/a
Yugo		0	2	3	5 41.7	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Chevrolet Beretta		0	1	0	1 8.3	0	0	0	0 0.0	n/a	n/a	n/a	n/a	n/a	n/a
Pontiac Boneville		0	2	1	3 25.0	0	0	0	0 0.0	n/a	n/a	n/a	n/a	n/a	n/a
Pontiac Grand Am (2 dr)		0	2	2	4 33.3	0	0	0	0 0.0	n/a	n/a	n/a	n/a	n/a	n/a
Pontiac Grand Am (4 dr)		0	0	0	0 0.0	0	0	0	0 0.0	n/a	n/a	n/a	n/a	n/a	n/a
Pontiac Grand Prix		1	2	1	4 33.3	1	1	1	3 25.0	n/a	n/a	n/a	n/a	n/a	n/a
Total		2	10	6	20 20.0	1	1	1	3 3.7	n/a	n/a	n/a	n/a	n/a	n/a
Total		4	29	17	50 24.5	3	9	7	19 11.3	0	n/a	7	23	18	48 33.3

¹The numbers in the body of the table show the number of problems reported in each cell. The number (N) shown in the total column excludes problem counts for installation interference, since this question was asked only if there was an installation problem. The percentage (%) is the total number of problems as a percent of total possible problems.

^bThe total numbers of problems in the indicated seat position are significantly different at the 95% level of confidence among the vehicles tested.

^dThe child seats were not tested in the front seat of the eight test vehicles with non-motorized automatic belt systems because these automobiles do not have manual lap belts in the front seats.

Exhibit 7

Total Installation and Use Problems
by Child Safety Seat: Toddler and Infant Seats

<u>Manufacturer/Model</u>	<u>Total Number of Problems</u>	<u>Percent of Possible Problems</u>
<u>Toddler Seats</u>		
Century 200	47	27.6
Century 2000 STE	42	24.7
Cosco Car Seat	36	21.2
Evenflo 7 Year	42	24.7
Evenflo Ultara	19	11.9
Fisher-Price	37	21.8
Gerry Guardian Convertible	37	21.8
Kolcraft Perfect Fit	30	17.6
Nissan Child Safety Seat	22	12.9
Pride Trimble Pride Ride	33	22.0
Strolee 609	47	27.6
Strolee 626	53	31.2
Strolee GT2000	35	20.6
Total/Average	480	22.0
<u>Infant Seats</u>		
Strolee 626	35	20.6
Century Infant Love Seat	20	11.8
Evenflo Dyn-O-Mite	27	15.9
Kolcraft Rock-N-Ride Carrier	35	20.6
Total/Average	117	17.2

total number of problems in each installation position was conducted separately for toddler and infant seats. No consistent statistically significant differences (at the 95 percent level of confidence) in total problems by child safety seat were found.

Exhibit 8 presents the data for toddler seats by seat location in the test vehicles. In the rear outboard position, the total number of problems differ significantly by child seat. Problems occurred most frequently with the Strolee 609, the Fisher Price Car Seat and the Strolee 626--problems were reported in approximately 40 percent of the trials for these child seats. In the front passenger position, differences by toddler seat in the total number of problems in the front passenger position are not statistically significant. For infant seats, no statistically significant differences by seat were found for any of the three installation positions.

The above analysis examines the child seats separately in relation first to vehicles and then to type of child seat. Appendix B and Appendix C display the data by test vehicle, child safety seat, and test position for toddler and infant seats. However, the data are of very limited use because the cells are so sparse.

Exhibit 8

Type of Seat Problem by Child Seat and Vehicle Seat Position: Toddler Seats¹

MANUFACTURER/MODEL	Rear Outboard					Rear Center					Front Passenger						
	Installation Problem	Rotation	Forward Motion	Total ^a N	%	Installation	Rotation	Forward Motion	Total N	%	Installation Problem	Installation Interference ^b	Operation Interference	Rotation	Forward Motion	Total N	%
Century 200	1	10	4	15	29.4	1	7	7	15	35.7	1	1	1	6	7	17	47.2
Century 2000 STE	1	7	4	12	25.0	2	6	3	11	26.2	1	0	3	8	7	19	52.8
Cosco Car Seat	3	6	5	14	27.5	0	4	4	8	17.8	1	n/a	1	7	5	14	38.9
Evenflo 7 Year	0	3	11	14	33.3	0	2	8	10	22.2	0	n/a	4	5	9	18	50.0
Evenflo Ultara	1	1	2	4	8.3	1	1	4	6	14.3	0	n/a	1	4	4	9	25.0
Fisher Price	0	12	10	22	43.1	0	2	1	3	6.7	0	n/a	0	6	6	12	33.3
Jarry Guardian Convertible	1	3	5	9	17.6	3	4	4	11	24.4	0	n/a	1	8	8	17	47.2
Kolcraft Perfect Fit	0	7	5	12	23.5	0	2	2	4	8.9	0	n/a	0	7	7	14	38.9
Nissan Child Safety Seat	0	1	3	4	7.8	0	1	1	2	4.4	0	n/a	0	8	8	16	44.4
Pride Trimble Pride Ride	2	5	2	9	20.0	5	7	3	15	38.5	0	n/a	1	4	4	9	32.1
Strolee 609	1	12	9	22	43.1	0	4	3	7	15.6	0	n/a	4	7	7	18	50.0
Strolee 626	2	10	7	19	39.6	1	8	6	15	35.7	1	1	6	6	6	19	52.8
Strolee GT2000	4	6	3	13	25.5	4	4	1	9	23.1	0	n/a	1	6	6	13	36.1
Total	16	83	70	169	26.4	17	52	47	116	20.7	4	2	23	84	84	195	42.4

¹The numbers in the body of the table show the number of problems reported in each cell. The number (N) shown in the total column excludes problem counts for Installation Interference, since this question was applicable only if there was an Installation Problem. The percentage (%) is the total number of problems as a percent of total possible problems.

^aThe total numbers of problems in the indicated seat position are significantly different at the 95% level of confidence among the vehicles tested.

^bInstallation interference was recorded only when there was an installation problem. N/A indicates that Installation Interference was not relevant for this reason.

References

Tom, J.C., Petersen, D.D., Ribbins, C.M., and Peters, R. Evaluation of the Comfort and Convenience of Safety Belt Systems in 1980 and 1981 Model Vehicles (Washington, D.C.: National Highway Traffic Safety Administration, 1981).

Ziegler, Peter N. Use of Child Safety Seats. (Washington, D.C.: National Highway Traffic Safety Administration, 1989).

Appendices

CLOSE THE PASSENGER DOOR AND THEN OPEN IT WHILE WATCHING THE AUTOMATIC SAFETY BELT OPERATION.

3. Does the child seat interfere with operation of the automatic safety belt? That is, does the belt bind up or catch on the child seat when the door is opened or closed? **CIRCLE ONE.**
- | | | |
|--|-----|---|
| | Yes | 1 |
| | No | 2 |

24/

- a. If you answered Yes, please describe the problem(s).

25-26/
27-28/
29-30/

4. Try to pull the child seat from side to side (car door to car door). Does the child seat rotate more than about 30 degrees or come loose? **CIRCLE ONE.**

- | | |
|---|---|
| Remains tight, or rotates no more than 30 degrees to either side | 1 |
| Rotates more than 30 degrees to either side but does not come loose | 2 |
| Seat comes loose | 3 |

31/

5. Grasp the top of the child seat and pull slowly toward the front of the car.

- | | | |
|---|--------------------|---|
| | CIRCLE ONE. | |
| Measure how far the child seat pitches forward from the car seat. | Less than 2 inches | 1 |
| Measure distance moved as shown below. | 2-5.99 inches | 2 |
| | 6-10 inches | 3 |
| | Seat comes loose | 4 |

32/

Be sure not to include any measured distance between the car seat and the child seat that exists before pulling on the seat.

B. INSTALL THE CHILD SEAT IN THE REAR OUTBOARD SEAT (DRIVER SIDE)

1. Was there any problem installing the Seat? **CIRCLE ONE.** Yes 1

33/

a. If you answered YES, please describe the problem(s): No 2

34-35/
36-37/
38-39/

2. Try to pull the child seat from side to side (car door to car door). Does the child seat rotate more than about 30 degrees or come loose? **CIRCLE ONE.**

- Remains tight, or rotates no more than 30 degrees to either side 1
- Rotates more than 30 degrees to either side but does not come loose 2
- Seat comes loose 3

40/

3. Grasp the top of the child seat and pull slowly toward the front of the car.

- | | | |
|---|--------------------|---|
| Measure how far the child seat pitches forward from the car seat.
Measure distance moved as shown below. | CIRCLE ONE. | |
| | Less than 2 inches | 1 |
| | 2-5.99 inches | 2 |
| | 6-10 inches | 3 |
| | Seat comes loose | 4 |

41/

Be sure not to include any measured distance between the car seat and the child seat that exists before pulling on the seat.

C. INSTALL THE CHILD SEAT IN THE REAR CENTER POSITION

1. Was there any problem installing the Seat? CIRCLE ONE. Yes 1

42/

a. If you answered YES, please describe the problem(s): No 2

43-44/
45-46/
47-48/

2. Try to pull the child seat from side to side (car door to car door). Does the child seat rotate more than about 30 degrees or come loose? CIRCLE ONE.

- Remains tight, or rotates no more than 30 degrees to either side 1
- Rotates more than 30 degrees to either side but does not come loose 2
- Seat comes loose 3

49/

3. Grasp the top of the child seat and pull slowly toward the front of the car.

Measure how far the child seat pitches forward from the car seat. Measure distance moved as shown below.

- CIRCLE ONE.
- Less than 2 inches 1
 - 2-5.99 inches 2
 - 6-10 inches 3
 - Seat comes loose 4

50/

Be sure not to include any measured distance between the car seat and the child seat that exists before pulling on the seat.

Installation or Use Problems by Child Safety Seat, Seat Vehicle, and Seat Location: Toddler Seats

MANUFACTURER/MODEL	SEAT LOCATION	Motorized Belt Systems								
		MAKE/MODEL								
		Dodge-Shadow	Ford-Escort	Ford Tempo	Mazda-626	Mitsubishi-Mirage	Nissan-Mazda	Peugeot-4055	Saab 900-Turbo	Toyota-Camry
Century-200	Front Passenger	2	0	2	3	2	2	2	2	2
	Rear Window	0	0	1	1	3	2	0	0	1
	Rear Center	0	n/a	1	2	2	1	2	2	1
Century-2000 STE	Front Passenger	3	0	1	2	2	3	2	3	3
	Rear Window	0	0	0	3	1	0	1	0	0
	Rear Center	2	n/a	1	1	2	0	1	0	0
Cosco-Car Seat	Front Passenger	2	1	0	1	1	2	2	2	3
	Rear Window	1	0	0	1	1	0	2	1	2
	Rear Center	1	n/a	0	2	1	1	0	0	1
Eventlio-7 Year	Front Passenger	2	1	1	3	2	2	2	2	3
	Rear Window	1	1	0	1	0	1	0	2	0
	Rear Center	1	n/a	0	0	2	1	0	0	0
Eventlio-Ultara	Front Passenger	0	0	0	2	2	1	2	0	2
	Rear Window	0	0	0	0	1	0	0	0	2
	Rear Center	0	n/a	0	0	1	1	0	1	1
Fisher-Price	Front Passenger	1	0	0	2	1	2	2	2	2
	Rear Window	2	0	0	2	2	2	2	2	2
	Rear Center	0	n/a	0	0	0	0	0	0	1
Gerry Guardian Convertible	Front Passenger	3	0	2	2	2	2	2	2	2
	Rear Window	0	0	0	0	0	2	3	0	2
	Rear Center	0	n/a	1	3	0	3	0	2	0
Knicraft-Perfect Fit	Front Passenger	2	2	2	2	0	2	2	0	2
	Rear Window	2	0	1	0	0	0	2	0	0
	Rear Center	0	n/a	1	0	1	0	0	0	0
Nissan Child-Safety Seat	Front Passenger	2	0	2	2	2	2	2	2	2
	Rear Window	0	0	0	0	1	0	1	0	0
	Rear Center	0	n/a	0	0	0	1	0	1	0
Pride Triable-Pride Ride	Front Passenger	1	0	0	2	0	2	2	0	2
	Rear Window	0	1	0	0	1	0	0	0	0
	Rear Center	1	n/a	0	3	2	2	1	0	1
Strobee-609	Front Passenger	2	1	0	3	1	3	2	3	3
	Rear Window	1	2	0	1	0	1	3	2	2
	Rear Center	2	n/a	0	0	0	2	1	0	0
Strobee-626	Front Passenger	4	1	0	3	0	3	3	2	3
	Rear Window	2	0	0	0	2	1	0	1	2
	Rear Center	0	n/a	0	0	1	2	2	3	0
Strobee-JT2000	Front Passenger	2	0	0	2	1	2	2	2	2
	Rear Window	2	1	1	0	0	0	0	2	2
	Rear Center	1	n/a	0	0	2	1	0	1	0
Total	Number	45	11	17	19	42	52	48	42	51
	Percent Possible Problems	34.6	12.1	13.1	37.7	52.3	40.0	36.9	52.3	39.2

Installation or Use Problems by Child Safety Seat, Test Vehicle, and Seat Location: Toddler Seats, cont'd.

MANUFACTURER/MODEL		Two Point Non-Motorized ^a			Three Point Non-Motorized ^a					Total (N)	Percent of Possible Problems
		MAKE/MODEL			MAKE/MODEL						
		Hyundai-Excel	Volkswagen-Jetta	Yugo	Chevrolet-Beretta	Pontiac-Bonneville	Pontiac-Grand Am (2 dr)	Pontiac-Grand Am (4 dr)	Pontiac-Grand Prix		
Century-200	Front Passenger	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	17	47.2
	Rear Window	0	0	2	1	2	1	0	1	15	29.4
	Rear Center	0	0	n/a	2	0	0	n/a	2	15	33.3
Century-2000 STE	Front Passenger	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	19	52.7
	Rear Window	1	0	2	0	1	2	0	1	12	23.5
	Rear Center	0	0	n/a	0	0	0	1	3	11	24.4
Casco-Car Seat	Front Passenger	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	14	38.8
	Rear Window	0	2	0	0	2	2	0	0	14	27.5
	Rear Center	0	0	n/a	0	2	0	0	0	8	17.7
Evention-7 Year	Front Passenger	n/a	0	n/a	n/a	n/a	n/a	n/a	n/a	18	50.0
	Rear Window	2	0	2	1	1	1	0	1	14	27.5
	Rear Center	0	1	n/a	1	1	0	1	2	10	22.2
Evention-Ultara	Front Passenger	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	9	25.0
	Rear Window	0	0	0	1	0	0	0	0	4	7.8
	Rear Center	0	1	n/a	0	1	0	0	0	6	13.3
Fisher-Price	Front Passenger	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	12	33.3
	Rear Window	1	2	0	2	0	2	0	1	22	43.1
	Rear Center	0	0	n/a	0	1	0	0	1	3	6.6
Gerry Guardian Convertible	Front Passenger	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	17	47.2
	Rear Window	0	0	1	0	1	0	0	0	9	17.6
	Rear Center	0	2	n/a	0	0	0	0	0	11	24.4
Hocraft-Perfect Fit	Front Passenger	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	14	38.8
	Rear Window	0	0	2	0	1	2	1	1	12	23.5
	Rear Center	0	1	n/a	0	1	0	0	0	4	8.9
Nissan Child-Safety Seat	Front Passenger	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	16	44.4
	Rear Window	0	0	0	0	0	0	0	2	4	7.8
	Rear Center	0	0	n/a	0	0	0	0	0	2	4.4
Pride-Triple-Pride Ride	Front Passenger	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	9	25.0
	Rear Window	0	0	3	0	2	0	1	1	9	17.6
	Rear Center	1	3	n/a	0	0	0	0	1	15	33.3
Strobel-609	Front Passenger	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	18	50.0
	Rear Window	1	0	2	1	2	0	2	2	22	43.1
	Rear Center	1	0	n/a	0	1	0	0	0	7	15.6
Strobel-626	Front Passenger	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	19	52.8
	Rear Window	1	2	3	0	2	n/a	1	2	19	37.3
	Rear Center	1	0	n/a	0	2	2	0	2	15	33.3
Strobel-GT2000	Front Passenger	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	13	36.1
	Rear Window	1	0	2	1	0	1	0	0	13	25.5
	Rear Center	0	0	n/a	1	1	1	1	0	9	20.0
Total	Number	10	14	19	11	24	14	8	23	400	28.0
	Percent Possible Problems	12.8	17.9	48.7	14.7	30.8	17.9	10.3	29.5	28.0	

^aThe child seats were not tested in the front seat of the eight test vehicles with non-motorized automatic belt systems because these automobiles do not have manual lap belts in the front seats.

Appendix C

Installation or Use Problems by Child Safety Seat, Test Vehicle, and Seat Location: Infant Seats

MANUFACTURER/MODEL	SEAT LOCATION	Motorized Belt Systems									Two Point Non-Motorized ^a			Three Point Non-Motorized ^a					Total (N)	Percent of Possible Problems
		MAKE/MODEL									MAKE/MODEL			MAKE/MODEL						
		Dodge-Shadow	Ford-Escort	Ford Tempo	Honda-626	Mitsubishi-Mirage	Nissan-Maxima	Peugeot-405S	Saab 900-Turbo	Toyota-Camry	Hyundai-Excel	Volkswagen-Jetta	Yugo	Chevrolet-Beretta	Pontiac-Bonneville	Pontiac-Grand Am (2 dr)	Pontiac-Grand Am (4 dr)	Pontiac-Grand Prix		
Strobel-626	Front Passenger	2	0	1	2	0	2	2	2	2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	13	36.1
	Rear Window	1	0	0	0	2	2	2	2	0	1	0	2	0	2	1	0	1	16	31.4
	Rear Center	1	n/a	0	0	1	0	0	2	0	0	0	n/a	0	0	0	0	2	6	14.6
Century Infant-Loose seat	Front Passenger	3	0	1	2	0	3	3	1	3	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	16	44.4
	Rear Window	1	0	0	1	1	0	1	1	2	1	0	1	0	0	0	0	0	9	17.6
	Rear Center	1	n/a	0	3	3	0	0	2	0	0	0	n/a	0	0	0	0	1	10	22.2
Eventlo-Dyn O Mite	Front Passenger	1	0	1	3	0	1	1	0	1	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	8	22.2
	Rear Window	1	0	0	0	1	1	1	1	1	0	0	0	1	1	1	0	1	10	19.6
	Rear Center	1	n/a	0	1	0	0	0	0	0	0	0	n/a	0	0	0	0	0	2	4.4
Kaiserl-Sub-8 Ride Courier	Front Passenger	0	0	0	2	1	2	2	2	2	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	11	30.6
	Rear Window	0	0	0	0	2	2	2	2	0	0	1	2	0	0	2	0	2	15	29.4
	Rear Center	0	n/a	0	0	1	0	0	0	0	0	0	n/a	0	0	0	0	0	1	2.2
Total	Number	12	0	3	14	12	13	14	15	11	2	1	5	1	3	4	0	7	117	22.2
	Percent Possible Problems	30.0	0.0	7.5	35.0	30.0	32.5	35.0	37.5	27.5	7.1	3.6	41.7	3.6	10.7	14.3	0.0	25.0	22.2	

^aThe child seats were not tested in the front seat of the eight test vehicles with non-motorized automatic belt systems because these automobiles do not have manual lap belts in the front seats.

27